

## **COPLINK: Developing Information Sharing and Criminal Intelligence Analysis Technologies For Law Enforcement**

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### **Abstract**

The COPLINK project ties together the law enforcement domain expertise of Tucson Police Department with the research and technical background of the University of Arizona's Artificial Intelligence Lab. Working closely together as a user-involved project, we have collaborated at all levels of development (design, testing, and implementation) and the result of our efforts are the COPLINK Connect database and Detect criminal intelligence applications. This paper highlights the technologies created as a result of our collaboration.

### **1. Introduction**

The challenges of being a law enforcement officer are many and exist at different levels. There are, of course, the dangers on the street, being the front line as protectors of the community. There is also a large workforce of law enforcement personnel working to solve crimes by searching for critical information. Unlike the popular view propagated by the television and film industries, law enforcement agencies are anything but cutting-edge in their use of information technologies for information sharing and criminal intelligence analyses. In reality, many officers, investigators, and crime analysts are minimally armed with large disparate datastores within their own agencies, which are often times difficult to use and have limited access. This, coupled with little or no information sharing between agencies, makes investigative tasks difficult and time consuming. In a field where time to locate and apprehend a suspect is critical, there is no room for error or for delay.

Under the umbrella of digital governments, the development of cutting edge information technologies for law enforcement is an important and challenging endeavor. Focusing on a previously neglected domain, issues of dealing with huge amounts of information, different types of legacy systems, security, end user needs and user characteristics all lead to the potential for significant impacts to digital government research and its influence on society. Funded by the National Institute of Justice and the National Science Foundation, the University of Arizona's Artificial Intelligence Lab has teamed with the Tucson Police Department (TPD) under the COPLINK project, focused on the development of different information technologies, including the Connect Database and Detect Criminal Intelligence Analysis applications.

The COPLINK project directly targets the problems of information sharing and criminal analyses within and between law enforcement agencies. The approach of this project is not merely one of user-centered design but one of user-involved design. To leverage law enforcement domain expertise and the University's research and technical capabilities, the COPLINK project revolves around the participation of Tucson Police Department law enforcement personnel serving as active members of the development team.

The COPLINK Connect database and Detect criminal intelligence analysis applications were developed to specifically deal with the problems and issues with information sharing and criminal intelligence analysis facing law enforcement agencies. We utilized a user-involved design methodology that led to the resulting design decisions, including data source identification and functionality. Design principles of platform-independence, stability, scalability, and an intuitive graphical user interface are the underlying foundations of the COPLINK systems.

## 2. COPLINK Connect Database

After analyzing user requirements, we created the COPLINK Connect Database application, employing a consistent and intuitive interface which integrates different data sources, such that the multiplicity of data sources remains completely transparent to the user, allowing law enforcement personnel to learn a single, easy-to-use interface. In addition to the interface design, we also developed a model that allows for information sharing both within and between law enforcement organizations.

### 2.1 Design Criteria

The main design criteria considered for the COPLINK project includes:

- **Platform independence**: Because not all police departments utilize the same hardware or software operating systems, platform independence was critical.
- **Stability and scalability**: The system also had to offer room for system growth and expansion.
- **Intuitive and ease of use**: The front-end user interface should be intuitive and easy to use, yet flexible enough to meet the equally demanding investigative needs of detectives and officers.

Typical law enforcement applications usually are legacy systems having out-dated performance and capability. For example, TPD's current Record Management System (RMS) took 30 seconds to answer simple requests and up to 30 minutes for more complex queries. Improved response time was critical to restoring departmental efficiency. To ensure application speed, issues of data and network communication, disk access and system I/O needed to be addressed. This also meant carefully distributing logic where it could be most quickly and efficiently executed, i.e., all user-input error checking should be done in the front end, and all database access logic achieved through pre-compiled stored PL/SQL procedures in the database.

Another critical issue, especially in designing a system that could be deployed across multiple law enforcement agencies, was acknowledging that no two agencies would store their incident data in exactly the same way. Therefore, it was important to come up with a data organization design that was flexible enough to be applied to any underlying data set. The database team designed a series of standardized "views" that fitted typical information search and presentation situations. For example, most of the data in the TPD systems were related to "Person," "Location," "Vehicle," or "Incident" information. A set of views was developed for each of these areas of interest, with the underlying data sets mapped to those standard views, making the system more portable to other law enforcement agencies.

## 3. COPLINK Detect for Criminal Intelligence Analysis

To complement the functionality of the COPLINK Connect Database application, our next phase of the COPLINK project was to develop a knowledge management tool specifically designed to aid investigators and detectives in criminal intelligence analysis. Drawing upon artificial intelligence techniques and algorithms, the COPLINK Detect was created.

COPLINK Detect utilizes a concept space, or automatic thesaurus, a statistic-based, algorithmic technique used to identify relationships between objects (terms or concepts) of interest. The idea of a concept

space, upon which COPLINK Detect is based, was generated to facilitate semantic retrieval of information.

In COPLINK Detect, detailed case reports are the underlying space and concepts are meaningful terms occurring in each case. Detect provides the ability to easily identify relevant terms and their degree of relationship to the search term. The relevant terms can be ranked in the order of their degree of association so that the most relevant terms are distinguished from inconsequential terms. From a crime investigation standpoint, COPLINK Detect can help investigators link known objects to other related objects that might contain useful information for further investigation. For instance, like people and vehicles related to a given suspect.

Information related to a suspect can direct an investigation to expand to the right direction, but a case report that reveals relationships among data in one particular case fails to capture those relationships from the entire database. In effect, investigators need to review all case reports related to a suspect, which may be a tedious task. In the COPLINK project, we introduce Detect as an alternative investigation tool that captures the relationships between objects in the entire database.

#### **4. User Evaluations**

The project also included a number of studies that evaluate the COPLINK applications. Our goals are framed from both the law enforcement and research perspectives, utilizing various qualitative and quantitative methods employed to test data correctness, usability, and efficiency.

##### **4.1. User Evaluations for the COPLINK Connect**

A usability evaluation, involving 52 law enforcement personnel, was conducted to assess the achievement of a number of the goals that guided the design and development of the COPLINK Database. Items on the questionnaire used to assess and compare the COPLINK and RMS systems were based upon user perceptions of such widely used measures of usability as: *effectiveness* (impact of system on job performance, productivity, effectiveness of information, and information accuracy), *ease of use* (measures of effort required to complete a task, ease of learning how to use the application, ability to navigate easily through the different screens, and satisfaction with the interaction), and *efficiency* (speed of completing tasks, organization of the information on the screens, ability to find information and the interface design itself).

Benchmark levels from TPD's current RMS system for all three usability factors were established and compared with COPLINK Connect ratings. In addition to written questionnaires, observation of the data collection methods and structured interviews were used both to supplement findings and to provide feedback for further development efforts. Data analysis of the usability questionnaire support a conclusion that use of COPLINK Connect provided improved performance over use of the current RMS system. On all usability measures (effectiveness, ease of use, and efficiency), participants rated COPLINK Connect higher than RMS, with the average rating for COPLINK being 4.1 and RMS being 3.3 (1=strongly disagree to 5=strongly agree). Statistical analyses revealed that this ratings difference was significant for all measures. From a limited deployment effort of COPLINK Connect at the Tucson Police Department, we were able to collect longitudinal data on the usage of the application, from the different types and number of search queries to specific real-life case examples. Currently, the Connect system is fully deployed at Tucson Police Department.

## **4.2. User Evaluations for the COPLINK Detect**

We conducted user evaluations to examine the effects of COPLINK Detect on law enforcement investigation and work practices. In an initial pilot study, twelve crime analysts and detectives, participated in the four-week longitudinal evaluation, during which they were asked to complete journal entries on searches they had conducted using COPLINK Detect. By utilizing data collection methods of documentation, structured interviews, and direct observation, we were able to evaluate the function and design of the COPLINK Detect system.

The journals and interviews revealed major areas in which COPLINK Detect provided support for intelligence analysis and knowledge management.

### **4.2.1. Link analysis and Summarization**

Participants indicated that COPLINK Detect served as a powerful tool for acquiring information and cited its ability to determine the presence or absence of links between people, places, vehicles and other object types as invaluable in investigating a case. The impact of link analysis on investigative tasks is crucial to the building of cases. An officer assigned to investigate a crime has to have enough information to provide a lead before he/she can begin working. Too many cases have to be closed because of lack of information or inability to utilize information existing elsewhere in the records management system. COPLINK Detect manages all the data in the records system in such a way that it can be used as knowledge about the suspect. Link analysis can represent one of three types: directly linking known information, indirectly linking known information, and linking unknown information.

### **4.2.2. Efficiency**

Perhaps one of the most crucial benefits of the use of COPLINK Detect in law enforcement is its speed. As one of our participants explained, identifying a suspect between 48 to 72 hours after a crime is difficult. Beyond this time frame, a suspect is able to destroy evidence that may tie him/her to the crime or change his/her appearance to avoid identification. Witness/victim memory of the suspect's appearance also fades within this period. Identification of the suspect ideally should occur within 48 hours of the crime, so establishing useful links for identifying and locating the suspect is a crucial step. A number of interview and journal comments indicated that use of COPLINK Detect increased productivity by reducing time spent per information search.

At this time, we are evaluating COPLINK Detect in a larger user study. We hope to deploy the Detect system within a couple of months.

## **5. Conclusion**

It should be evident that we are excited about the results of the COPLINK collaboration effort, from both the potential impact in the research community as well as in application as an example of digital government technologies being used to help the people. From the user analyses of the COPLINK technology, we will also present some examples of actual criminal cases with user comments. As part of this conference, we would like to provide a system demonstration of the COPLINK applications. Highlighting the outcomes of the user-involved design, we will demonstrate the functionality and resulting design of the COPLINK systems.

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